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MEMORANDA

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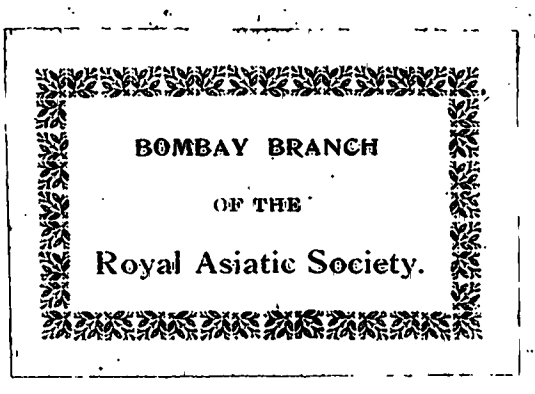

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MEMORANDA

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MEMORANDUM

By MAJOR-GENERAL CULLEN,

ADDRESSED TO THE MADRAS GOVERNMENT, ON THE 5TH DECEMBER, 1843.

A RECENT Circular from the Asiatic Society containing instructions for the collection of information regarding the mineral, vegetable, and other products and resources of our Indian Empire, have induced me to offer some suggestions with the same view, but applicable more immediately to our own Presidency, and which while they may, it is hoped, appear easy of attainment, will also I think materially tend to promote an early and systematic collection of the desired information.

2. Instead of leaving these objects as hitherto entirely to the chance and unconnected exertions and contributions of individuals, I would propose that it should at once be made a subject of Government solicitude involving it however in no new or expensive Establishments: I would merely suggest for the consideration of Government whether it might not with propriety request the aid in this undertaking of its own servants in the Provinces, both Civil and Military, and of those more especially whose appointments and professional duties must enable them powerfully to promote such researches, the Collectors of Districts and Civil Engineers.

3. It is I believe upwards of twenty-five years since the Literary Society of Madras first directed their attention to the formation of a Museum, and although specimens of the rocks and minerals of almost every part of the Madras Presidency from Cape Comorin to the Nerbuddah have at different times been presented, they have not I believe been yet turned to any useful practical purpose, and after this long interval it is nearly as difficult as at first to acquire any distinct conception, or to obtain any account, of the formations or mineral or other products of the various provinces of this Presidency.

4. The Members of the Society at Madras have in general too much occupation in their respective offices to be enabled to devote any large share of their time or attention to the useful arrangement of, or to drawing up, popular accounts of these collections so as to adapt them for the guidance of those engaged in such researches in the Mofussil; it is a duty also which, to be performed with full advantage would require some personal acquaintance with the Districts to which the observations may apply.

5. Some recent enquiries of my own which led me to notice the presence of graphite in the formations of Travancore, and its existence also in the corresponding parallels on the Eastern side of the Ghats in Tinnevelly, and the apparent coincidence in direction of both of these with the strata in Ceylon which afford the same mineral, drew my attention strongly to the subject, and to the existing want of concert and co-operation in such enquiries, and the consequent loss of all the valuable local information collected from time to time by individuals, which from their having neither the means nor encouragement to bring them into notice at the Presidency, are seldom preserved, and the knowledge of the features and resources of the Districts has again to be acquired by every succeeding new comer.

6. The present system of appointing Civil Engineers to the several Districts appears to me to offer peculiar facilities and advantages for the collection of statistical information of the kind desired by the Asiatic Society, and the highly scientific education and accomplishments of these officers, and the peculiar nature of their duties which carry them over every part of their respective Districts, and lead them minutely to study its features with a view to the extension of irrigation, the formation of roads, &c., afford them also singularly favorable opportunities of collecting and recording information regarding their various resources.

District Museums.

7. I would not however propose that these collections should as hitherto be forwarded to Madras, at least not in the first instance. It would be preferable I think to form local Museums, a small Museum for every Collectorate, and for which a room might probably be set apart in each Cutcherry or Court House—the Museum to be under the charge of the Collector (assisted by the Engineer and Medical Officer) and who could also probably afford a servant to look after it.

8. The advantage of having such a Museum in a Public Building and under charge of the Collector will be evident—no person is likely to be more interested than the Collector himself in possessing such a Museum for his own information and reference, and he would doubtless himself as well as his Assistants promote the objects of it to the utmost of his power. In a Public Building also it might be rendered at all times available for the inspection of every person interested in the subject and to scientific travellers who would not only derive much interesting information themselves, but would probably occasionally contribute to the value of the collections by their own remarks and suggestions.

9. Many persons who might hesitate to submit a collection of minerals, or their observations upon them, to a learned Society at Madras, would readily contribute their mite to a local collection such as I have suggested.

10. In the course of two or three years probably a very good collection of the more prevalent rocks and minerals might be formed, and a tolerably correct memoir might be drawn up of their relative extent, with lists of the more valuable or rare ores, minerals or other products, their localities, &c. &c., and these might be corrected from time to time as farther information was acquired. The Civil Engineers being all officers of the same Corps, would naturally communicate with each other on the subjects of their enquiry, and by thus acting in concert would still farther promote the objects in view.

11. From these Local or District Museums, contributions might from time to time be made to some general Depôt at the Presidency to be also placed under an officer of the same Corps, perhaps most appropriately under the Secretary to the Department of Public Works under the Board of Revenue, for it ought I think in all respects to be a Government measure, without which it cannot be expected to succeed, and surely it will be well worth the care of Government to promote an undertaking that is likely to be attended with little or no expense to it, and yet offers so apparently certain and expeditious a mode of drawing up a memoir on the resources of this Presidency. The Museums in the provinces being under the Collectors and Civil Engineers, it is but following up the plan to place the General Museum at Madras under the Board of Revenue and Head of the Civil Engineer Department, as the body most interested in giving effect to the views of Government, and thus completing the chain of communi-

cation. I hardly think that any other plan would work with equal certainty. It would be an object also of course to furnish specimens to the scientific bodies.

12. If these suggestions should be considered worthy of notice, probably a small collection of rocks and minerals with a few of the best works on the subject from England for the use of each District might be provided at a mere trifle as to expense; and these cabinet collections might perhaps be formed with reference to the already known general character or formations of each District. A small box of chemical tests might also be added, not only as necessary to determine the character of certain minerals, but also for their occasional analysis or that of the soils of the different parts of a District.

13. The formation of these Local Museums under the countenance of the Government would probably also induce Members of the Service at out-stations to meet together occasionally to examine and discuss the subjects of interest presented for their consideration, nor would their researches I hope be limited to the mere collection of minerals, but that they would naturally and in due time be extended to every other branch of information comprised under the head of Statistics. No work has yet I believe appeared that has offered more minute and valuable statistical information for the time it was written than that of Francis Buchanan on Mysore, Malabar, and Canara. It might indeed in many respects still be considered a valuable guide to such enquiries.

The more influential natives of the several Districts would also probably take considerable interest in such an undertaking, more especially when they perceived that it was likely to lead to the encouragement of agriculture or trade, by suggestions for the improvement of existing processes or by bringing into notice products hitherto unknown or altogether overlooked.

14. We have yet no good or scientific paper on the interesting and extensive deposits of gold dust or its matrix which occupy so large a portion of the Calicut Collectorate from the Sea Beach between Beypoor and Ponany to an altitude of 3,000 feet on the table land of Mysore near the foot of the Neddiwuttum Ghat and the sources of the Beypoor River. Neither have we yet any account of the former extensive workings of lead ore in the limestone strata at Jungumrazpilly near Cuddapah, although those Districts have now been in our possession forty years. I visited these latter workings in 1822, and

the former in 1819, and presented numerous specimens to the Society.

15. The Districts of Cuddapah and Bellary, and the whole chain of Ghats from Tripetty to the River Kistnah, and to which Kurnool may now be added, are full of geological and mineralogical interest. These tracts, besides being the depositaries of ores of copper, lead and the diamond, abound also in materials that might be extensively employed for economical purposes, such as sandstones, limestones and roofing slate, &c. &c., of every variety of texture and colour.

16. The Peninsula south of the Nerbuddah, which a few years ago had been supposed to be composed almost exclusively of primary strata, is now found to exhibit most extensive tracts of secondary and even tertiary and still more recent formations.

Tinnevelly abounds in recent calcareous deposits, while in the primary tracts of Malabar, are most singular and extensive, and yet unexplained carbonaceous deposits.

17. I have here attempted imperfectly to indicate a few only of the points of interest for enquiry, and in one of the branches only; but there are innumerable others in this, as well as in various other branches of statistical research, which will doubtless readily occur to those who have a more perfect knowledge of the subject.

Barometrical Levelling.

18. There is yet another subject of great interest, but to which little or no attention has hitherto been paid, I mean levelling by the Barometer for the purposes of inland navigation, of irrigation, or of roads. It is a subject so intimately connected with the pursuits of the Civil Engineer, that I venture also to introduce it in this place, and as a mode of levelling that might be adopted generally with the greatest advantage, not to supercede the old method which is perhaps absolutely necessary when a line has been fixed upon, but as a most important auxiliary and as a mode of determining expeditiously and with great general correctness the practicability of any proposed line of communication.

If for instance the practicability of connecting two rivers was to be ascertained, or that it was wished to bring a river several miles distant into some large tank, this could only be determined in the usual way by a tedious operation of probably several days, more especially if the country was hilly or close and jungly: with Barometers the relative levels of the two extreme points might be determined probably within eight or ten feet or less in the

course of one day, as well as the general level of the intermediate ground; but it is not so much with a view to any specific case that I would suggest the more general use of the Barometer but as an instrument that might constantly accompany an Engineer on his journies, and from which he might draw up tables of levels over every part of his District, and by placing them, as sections on record, afford himself or his successors opportunities at any time of more readily deciding upon the probable practicability of any plans of inland communication or of irrigation that may be proposed.

19. Long experience of the Barometer myself has given me great confidence in its application to these purposes, and these instruments are in the course of daily improvement. The Barometer may be carried under the bedding of the palankeen. I have carried it so for the last twenty-five years; or they may be placed in a box and carried slung between two careful coolies—a plan which I have latterly adopted where I had several Barometers, and travelled slow. Each Engineer should I think be furnished with at least three or four Barometers: one or two as standards invariably to be lodged and registered daily at the Cutcherry; the other two to accompany the Engineer on his tours. Lieutenant Horsley, of the Engineers, at my suggestion three years ago on leaving Travancore for Tinnevelly furnished himself with Barometers, and has not only now I believe collected a great deal of valuable information relative to the general levels of his District, but has had reason to remark the singular and close correspondence of the results by the Barometer with those from the ordinary levelling instruments.

Letter from Mr. Hill, Secretary to Government, to Board of Revenue, 30th April, 1822.

Revenue letter from Court of Directors, 29th Sept., 1824.

20. The Board of Revenue are in possession of some very extended sections made by me in the year 1819, '20, and '21, but these were made with a single Barometer only and no very great accuracy was expected or aimed at: the object then was merely to exhibit the general features and relative levels of the various Districts under this Presidency. The general accuracy however of the several stations was sufficiently remarkable, for as I passed over many of the points of the great Trigonometrical Survey by Colonel Lambton, I had frequent opportunities of verifying the results obtained from this instrument. I have continued to carry Barometers with me up to the present moment, and subsequent experience has confirmed me in the opinion of its correct indications if the observations are made with care, and the person using it has

acquired a little practice and experience. As a few examples of the results by the Barometer in ordinary levelling may be satisfactory, I venture to offer some taken from my sections of 1819-20, as well as from subsequent observations.

1. On a march from Bellary to Secundrabad in 1820, I had to cross the Toomboodra and Kistnah Rivers, the former at Madaveram, and the latter at Celachabutra Ghat; the distance between them being thirty-two miles.

The Kistnah by Barometrical observation appeared to be sixty feet higher than the Toomboodra.

2. On a march from Beizwarrah on the Kistnah, to Rajahmundry on the Godavery, in 1821, desirous of ascertaining the relative levels of those two great rivers with reference to that of the Colar inundation or lake, I found the bed of the former to be upwards of fifty feet higher than the Godavery, and this I afterwards learnt agreed within a few feet with the result of a tedious series of levels taken with the common levelling instrument several years before, by Captains Torianno and Caldwell, of the Engineers.

3. At Bellary, in 1822-23, a station badly supplied with water, I employed myself in examining the surrounding country, with a view to bring some of the small streams of that vicinity up to that station. The project did not appear impracticable from the Hoggree and other smaller rivers, though required to be taken off at a considerable distance to overcome the difference of level.

4. I ascertained also that the Toomboodra River, near Hospett, was nearly on the same level as the town of Bellary, and therefore that a canal taken off a few miles higher up might probably be brought up, by Darogee, near to that great station, and made to irrigate the large tract of country between it and Sirgoopah to the Northward, and not only to serve for irrigation, but for the transit of timber or other produce, an object that might perhaps with advantage be kept more in view *in all our works of irrigation*. There are one or two obstructions midway between Cumlapoor and Darogee, but not insuperable.

Letter from Major General Cullen to Government, dated Quilon, 21st of October, 1840, and

5. The Barometer also discovered to me a fall in the Toomboodra River within the enceinte of the old city of Beejanuggur in an interval of only eight miles of not less than two hundred and fifty feet, and it was this great fall that enabled its Princes to circulate streams of water over every portion of that formerly magnificent and celebrated city, and its still most beautiful and interesting ruins.

6. The failure of the Canal which, at an expence I believe of four or five lacs of rupees, a late Dewan of Mysore, Poorneah, cut from the Cauvery River to Mysore, is probably well known. It was cut some years subsequent I believe (about 1806-7) to the fall of Seringapatam, but at the town of Mysore the bed of the Canal is about fifty feet below the general surface of the ground. In 1825-26, I went out to the dam across the Cauvery, constructed for the supply of this canal with water. It is at a place called Tippoor, about twenty miles above Seringapatam, and about the same distance in a direct line from Mysore, or seventy miles by the windings of the canal. I found the top of the dam by the Barometer to be actually *below the general level of the town of Mysore.*

Extract from letter from Col. Sim, Chief Engineer, in 1836.

"Your observations clearly shew that a channel may be opened with great advantage to the cultivation of the country from the Cortillyaar, somewhere near the junction of the Naggery stream."

"It was your enquiries that suggested the investigation."

7. Having long entertained an idea that the large Tank at the Red Hills, near Madras, might be permanently supplied with water from the Cortillyaar, in 1832-33, I took a series of levels with the Barometer from that river in the vicinity of Trippasoor, by Ramatandalum Paakum and Vellacherry to the South end of the tank near Trimallivail. The bed of the tank at its South end near Trimallivail appeared to be eighty feet lower than the bed of the river near Trippasoor, and there seemed to be no difficulty or obstruction to overcome in the intermediate country. This levelling by the Barometer agreed also closely with a series of levels taken about the same time by the officers of Engineers.

The bed of the tank appeared to be six or eight feet above the Esplanade of Black Town, and its waters therefore capable of being carried on thus far: this also appeared to me to be an instance where the transport of produce might perhaps be combined with that of irrigation.

8. In Travancore, the Tambrapoorny or Paralayaar River near Poonmoonna is the chief source of supply of all the channels of irrigation in Nunjinaud for the Districts of Thovalla, Agateshwerom, Kulcolum, and Erneel, four only out of the thirty-two talooks of Travancore, yet returning one quarter of the total land revenue, but it is a small river and unless the monsoons are very abundant, is never sufficient for the cultivation. Some fifty or sixty years ago, a celebrated Rajah of Travancore, called the Ram Rajah, wished to bring the waters of the Codiaar, a river in the Vellavencode District into those of the Tambrapoorny, and he constructed a magnificent dam across the former river and cut a fine canal from the Codiaar to Poonmoonna,

a distance of eight or ten miles, through a most difficult country. When the work however was completed, it was discovered that the bed of the Tambrapoorny, instead of being lower, was actually higher than that of the Codiaar, and the water flowed it is said but a short way up the canal. One end of the dam afterwards gave way, and it has since been altogether neglected. This line of canal has however been more recently several times surveyed in order to establish beyond doubt the relative levels of the two rivers: the latest survey was by Lieut. Horsley in 1836-37, he made the difference of level thirty-one feet, and his surveyors were I believe upwards of two months occupied on the work. A series of levels were taken I believe several years before over the same line, and the difference between the two rivers was then estimated at only two or three feet, proving that discrepancies may arise even in this mode of levelling; nor is it perhaps to be wondered at when we consider what innumerable observations are required to be made, and the many sources of error both instrumental and of observation. I visited the ground in company with Lieut. Horsley in 1841; we were there two days, and the difference of level by Barometer appeared to be about ten or fifteen feet, or a mean between the two previous levellings.

9. A few days since only, His Highness the present Rajah of Travancore wished to determine the practicability of cutting a canal between two small rivers, the Caramany and Killiar, within six miles of Trevandrum. I placed Barometers on both rivers, and made the difference of level about sixteen feet. Assistant Surveyor Armstrong has subsequently gone over the ground with his levelling instrument and makes the difference of level twelve feet. The distance was nearly 1½ miles with a hill between and much high jungle.

21. I could give many similar instances of the satisfactory results of the Barometer, but other observations of great general interest may be made with it. It may be interesting to record the average fall of all our principal rivers: few of these are navigable, and this chiefly perhaps owing to the direction of the strata which almost invariably cross them; but it may be of interest to know, for instance, that the Toomboodra, not far from its source at Honelly, is not 2,000 feet above the sea, proving that the rate of fall in the country to the Eastern coast should not be unfavorable to a water communication.

I have many levels taken at different points in its course.

A proposal was made in 1821-22, by the Chief Engineer to Sir Thos. Munro that Capt. Cullen should be employed to take the levels by Barometer from Ponany to the E. Coast, but it was not carried out.

Capt. Cullen however subsequently took levels in 1827 and 1832, 1841, &c.

22. The practicability of effecting a canal-communication between the sea at Ponany and the Cauvery River near Caroor, is a project that has I believe been more than once entertained, but I do not believe any useful data on the subject were ever collected; yet the general practicability of such a scheme might have been ascertained in a few days without difficulty by the Barometer.

The absolute height above the sea of some of the towns in Coimbatore, &c., had probably already been recorded in the Trigonometrical Surveys; but these were not generally accessible, and the points so determined were probably but few. It is not perhaps very generally known that notwithstanding the open and apparently level surface of the great break in the ghats between Coimbatore and Malabar, the country at Polatchi is not less than 1,000 feet above the sea.

23. In providing Barometers, it will of course be desirable that they should be procured from some maker of established reputation for their construction, and all ought I think to be procured from the same individual, so as to ensure more perfect uniformity. I would I think recommend the ordinary Englefield Mountain Barometer as under all circumstances the simplest and the best for such purposes, having a nut on the side to work the index. I procured lately some very good wooden case Barometers of Sir H. Englefield's construction from Troughton and Simms. I have never yet succeeded in getting a good Newman's Iron Cistern Barometer: one lately sent to me was broken on arrival, and I believe the weight of the iron cistern frequently causes similar accidents; but I am rather disposed to prefer the wooden cistern—some practical directions for the use of the Barometer in such levelling might easily be drawn up if it is required.

24. Long practice in the use of the Barometer, and the great amusement and interest that it has afforded me for so many years past, have perhaps led me to attach more value to its indications, and to its application to useful practical purposes, than those unused to it may at first be disposed to concede.

It is only however of late years that Barometers have come at all into general use under this Presidency even for ordinary meteorological purposes. In 1819-20, except at the Madras Observatory,[a] and at Hyderabad, with Col. Lambton and Dr. Voysey, I do not recollect meeting with a single Barometer at any station of the Army. I was necessarily therefore for the most part obliged to calculate

[a] where the only object was to correct refraction.

the altitudes from the successive daily observations of my own Barometer, an approximate method however susceptible of great general accuracy if due attention be paid to the laws which influence the diurnal oscillations.

25. Another object of enquiry which I think might be advantageously associated with the foregoing is, that of the fall of rain under the several Collectorates of this Presidency. **Fall of Rain.**

The Barometer, Thermometer, and Rain, have I believe for some few years past been ordered by the Medical Board to be registered at most of our chief Military stations; but these are with a view chiefly to observations upon climate and its effect upon the constitution: nor are they published in a form that render them available for the purpose of the agriculturist. Observed also at the chief Military stations only they do not afford a fair estimate of the fall of a whole Collectorate, but by keeping registers at every Civil station also and publishing them perhaps periodically in the Gazette, information of much interest would be placed on record, useful alike probably to the Government and the public, as connected with the state of the crops and prices of grain.

I have placed rain guages for the last two years at ten or twelve different places from Cape Comorin to near Palghat, including two or three stations in the Tinnevelly District, and the results are extremely interesting and curious.

26. The fall of rain along the coast seems to diminish gradually from Bombay towards Cape Comorin.

In 1842 at Cannanore it was	120.
Cochin	109.
Allepey	104.
Quilon	81.
Trevandrum	58.
Nagercoil	36.
Cape Comorin about	20.

These are the results of common tin rain guages three feet long and scale four inches to one. The results are probably rather below the truth.

It is curious also to observe the sudden and great diminution in the quantity of rain at the short distance of even fifty miles from the coast, whether there be a continuous line of ghats, or a great break or opening of thirty miles wide, as at Palghat.

At Chittoor, near Palghat, and in the midst of that great opening, the fall of rain in 1842 was only	52.
At Shencottah near Courtallum	40.
At Palamcottah only	23.

27. In the recent experiments on the cultivation of American cotton, I doubt if the fall of rain, or the degree of humidity of the climate have been sufficiently considered; that of Palamcottah would hardly seem to have been favorable for such experiments, and these results may afford an illustration of the value of such information. The fall of rain in Tinnevelly seems to me to be less even than that of Bellary, another of our great Cotton Districts.

(Signed) W. CULLEN,

Major-General.

COCHIN, *5th December*, 1843.

The differences of temperature and of the fall of rain at given altitudes are still desiderata I believe; yet information of much interest might easily be collected by ordering a series of observations at all places where there are Light-Houses, such as Madras, Coringa, Cochin, &c. &c., and where it is under any circumstances necessary to visit the tops twice a day.

Extract from a Letter from Lieut. W. HORSLEY.

Palamcottah, 28th November, 1843.

With regard to Barometrical levelling, my attention was first drawn to the subject by observing the close agreement between a series of levels taken with the ordinary levelling instrument, and the results of your Barometrical observations along the course of an old channel from the Codayaar to the Paralayaar, in the South of Travancore, in January 1841. A farther acquaintance with the instrument soon shewed me that considerable accuracy might be attained by careful observations in determining the relative levels of rivers, channels, &c., and that the Barometer might in this way be turned to good account as a pioneer to the levelling instrument. On my quitting Travancore, in February 1841, you were so kind as to lend

ne one of your Mountain Barometers, a portable one by Carey, with which instrument I have since constantly observed, carrying it with me in my palankeen wherever I go. In the course of my tours through the Districts of Tinnevelly, Madura and Dindigul, I have had frequent opportunities of testing its merits, and the observations I have made will enable me at some future day when I have more leisure to determine the height above the sea of every place that I have visited, and to lay down a series of sections through the length and breadth of the land, which cannot fail to be of service to all who come after me. As a pioneer to the levelling instrument, I have found the Barometer of great service: for instance, a new channel extending over several miles is proposed to be opened for purposes of irrigation. To ascertain the practicability or otherwise of the project by means of the levelling instrument would be the work of days, perhaps of months, whereas by taking a few observations at certain distances along the line with the Barometer, which may be effected in one day usually, a tolerably correct idea can at once be obtained of the relative levels of the extreme as well as intermediate stations. The result will shew whether it is worth while to prosecute the enquiry with the levelling instrument. Should the project appear evidently impracticable, much time and trouble will be saved. I have also found the Barometer useful as a check upon Surveyors, when working alone with the levelling instrument. In 1841, I had occasion to take a series of levels along the bed of the Tambrapoorny from Palamcottah to the sea, and availed myself of the opportunity to test the correctness of the Barometer observations. Here again I found the latter to agree very nearly with the former, and that at every station, evidencing at once the correctness of the levelling operations and the utility of the Barometer to a Civil Engineer.

In December 1841, I received two new Barometers by Troughton and Simms, from England, of a very superior construction: one of these I have placed under the charge of Conductor Darling in the Arsenal at Palamcottah, in order to obtain daily observations at a fixed station, and the other I usually carry in my palankeen and observe in common with yours at each halting place. The advantage of having fixed observations is very great, as it enables the itinerant observer to ascertain what portion of the total rise and fall in the mercury is due to atmospheric changes, and what to difference of level between any two places visited on different days. I need only add that the

more I know of the instrument, and the use to which it can be turned, the more I appreciate its merits and your kindness in making me acquainted with the subject.

(A true Extract.)

(Signed) W. CULLEN.

Drawn up by desire of the Government of the Marquis of Tweeddale.

MEMORANDUM ON THE BAROMETER.

1. In the paper recommending the introduction of Barometers for taking levels or sections of the country for the purposes of irrigation, canal, or road communications, it is proposed that at least two Barometers shall be employed, one always to remain at a fixed station, and the other to accompany the Engineer on his tours.; nothing therefore would be requisite but to make the observations in both places at stated hours, and the difference between the indications of the two Barometers will be the difference of level of the two stations.

2. As however rules for observing in such cases, together with printed tables of the several corrections for temperature, capillarity, &c. &c., are always furnished with the instruments, it will hardly be necessary to repeat any such instructions in this place: the present paper therefore will be limited to a few such general remarks as may perhaps be found useful to a beginner, and who has only one Barometer to work with, as was my own case for a great number of years.

3. Where there is but one Barometer and no means of comparison with another at a fixed station, results of great practical accuracy and utility may nevertheless be obtained, by carefully recording the dates and hours of observation, and applying certain corrections with reference to the known diurnal and other periodical oscillations of the mercurial column. Of course such results will in general be less perfectly accurate than those from contemporaneous observations with one of the Barometers at a fixed station, more especially if continued for a considerable interval, but they are much more correct than perhaps is generally supposed.

4. The Barometer is highest about 9½ A. M., and lowest about 4½ P. M., *i. e.* during the day; at night it is highest about 10 P. M., lowest about 4 A. M. The mean height of the Barometer taken from the two observations at 9½ A. M. and 4½ P. M. will also be found very nearly by a single observation at 7 or 7½ A. M. from 12½ to 1½ P. M., 7 or 7½ P. M., and at about 1 A. M. The daily rise or fall

of the Barometer appears to be, when *travelling*, about $\frac{1}{8}$ (·120) of an inch; when *stationary*, rather less; but the amount of oscillation, as well as the precise hour of maximum and minimum, &c., vary a little with the season of the year. For instance, $8\frac{1}{2}$ A. M. and $3\frac{1}{2}$ P. M. may perhaps be about the maximum and minimum hours in December and January, while $9\frac{1}{2}$ and $4\frac{1}{2}$ will represent the maximum and minimum more accurately in May and June. Each of the four daily oscillations or tides of the Barometer, occupies from five to six hours, so that one-fifth or one-sixth of the average daily oscillation will represent very nearly the correction to be applied to observations made at any other than the normal hours of $9\frac{1}{2}$ and $4\frac{1}{2}$.

5. The extent of oscillation appears to be greatest in the months of March, April and May, and it is then also subject to greater irregularities even in weather apparently fine, caused perhaps by the accumulation, and imperfect communication, of electricity between the atmosphere and earth in that season.

6. The average daily oscillations of the Barometer are less apparently during the prevalence of the rainy season than at any other period of the year, though they are also rather less than the average in the cold season, *i. e.*, during the months of December and January.

7. In daily marching over the country, all that is necessary is to record the height of the mercury at $9\frac{1}{2}$ A. M. and $4\frac{1}{2}$ P. M., and from the mean of each day's observations to find the difference of level of the two stations; of course if there be leisure, observations should also be taken at other hours of the day and night, in order to afford every possible opportunity of correcting those means, should any alterations be taking place in the atmospheric pressure, independent of mere diurnal oscillation: but in settled weather it is probable that all material changes which take place affect the whole atmosphere over a large space of country, so that no great errors are likely to arise in observations made in daily marches of only ten or fifteen miles.

8. In support of this, it may be noticed that in the Barometrical Sections submitted to Government twenty-two years ago, the altitudes of all the principal stations obtained in the above way corresponded, it is believed, in a remarkable degree with those determined trigonometrically by Colonel Lambton: a few of them are subjoined.

From Capt. C.'s observations.

Seringapatam	2321
Bangalore	2986
Bellary	1575
Secunderabad	1846
Nagpoor	932
Jaulnah	1652
Aurungabad	1893
Bieder	2330

9. Colonel Lambton and Dr. Voysey were at Secunderabad in June 1821, and it was very satisfactory to find that the results by the Barometer after 38 days' marching from February to June, and over near 500 miles of country from Goa viâ Belgaum, Darwar and Bellary to Secunderabad, agreed within five or six feet of his, determined trigonometrically. Bangalore, Bellary, Bieder, &c., also it is believed agreed closely, but no references are at hand.

10. In the months of April and May alone, after a long march, there were found errors of any considerable magnitude. In May 1821, on a march from Secunderabad, which is one thousand eight hundred feet above the sea to Masulipatam on the Sea Coast, an error was discovered on reaching the sea of nearly one hundred feet—an error which there is reason to attribute, as already noticed, to the *peculiar* electrical state of the atmosphere at that particular season. Similar discrepancies were met with on a march from Madras to Bellary in the same season in the year 1822, but these were almost the only instances in three years of continuous marching.

These errors on arrival at Masulipatam in 1821, and at Bellary in 1822, were afterwards corrected by contemporaneous observations obtained from the Madras Observatory and at Bellary, (the two Barometers having also been compared,) and were found to have occurred on both occasions almost entirely at one or two particular points in the route.

11. In the Barometrical Sections before Government, more particularly after leaving Secunderabad for Nagpoor, not only were frequent observations made in the course of the day and before starting in the mornings, but the height of the mercury was recorded at all rivers, and at all remarkable irregularities of surface in the course of the route, so that the Sections from Secunderabad to Nagpoor, and thence to Jaulnah, and by Secunderabad to Masulipatam, exhibit nearly accurate profiles of the whole route.

12. On the several corrections to be applied to ob servations with the Barometer, perhaps the accuracy c that which regards the differences of temperature may b questioned, at least in its application to the present ex tent: the temperature of the column of mercury in th Barometer seldom corresponds with or follows accurate the indications of the attached Thermometer. This ob- servation is hazarded chiefly however with reference to travelling; when stationary, they of course agree more perfectly, but it may be doubted whether even then they ever do so precisely.

Indeed from a series of six months' observations fro July to January, made at Bangalore with a Newman's Ba rometer with one Thermometer in the cistern, and anothe out, the differences between the two, although stationar in a room, amounted to as much as 2° occasionally.

	At 9½ A. M.	At 3½ P. M
In July the difference...	0°	1°
January „	1°	2°

In travelling there will frequently be a difference i the Thermometer of 20° and upwards in two or three hours within a palankeen, and it may reasonably therefore be doubted whether the Barometer is affected with equal rapidity. I have had frequent reason to doubt whether the changes of temperature in the Barometer, under such circumstances, exceeded above half or two-thirds of that of the attached Thermometer within the same interval of time. On ordinary occasions, where the range of the Thermometer is small and full time for the Barometer to acquire the temperature of the air, the above remarks of course are less applicable.

13. Although of course it is desirable, where a tra veller has the opportunity, to compare his Barometer wit another at a fixed station and thence to determine his alti tudes from *contemporaneous observations*, yet even whe not actually compared with a stationary Barometer, th observations of the latter may nevertheless occasionally b turned to excellent account, for by noticing all changes i its daily mean height, and by allowing for these a correc- tion may be applied to the *travelling* Barometer, which will give nearly as accurate results as those derived from contemporaneous observations with a compared Barometer. In a tour of about eight days in the neighbourhood of Bellary in 1824, that station on returning to it came out forty-six feet too low, but on referring to the oscillations

of another stationary Barometer, it was ascertained that there had been irregularities in the mean height of the Barometer on different days, which almost exactly accounted for the above error as is exhibited below:

	Mean height of Barometer.	
	Higher.	Lower.
March 2d, ...	... 7.	0.
„ 3d, ...	... 13.	0.
„ 4th, ...	... 0.	5.
„ 5th, ...	... 0.	80.
„ 6th, ...	... 0.	28.
„ 7th, ...	... 0.	15.
„ 8th, ...	... 75.	0.
	95.	128.
		95.
		Error... 33 feet.

These corrections however should be applied to each day's observations.

14. This mode of correcting the indications of a travelling Barometer for the fluctuations in the general atmospherical pressure, and which could not otherwise be detected, may be found to be perhaps almost as satisfactory as that of determining altitudes from the actual comparison of two Barometers: a travelling Barometer may be deranged by some accident and its original point of comparison lost, but if furnished with the fluctuations in the mean height of *any* neighbouring Barometer, he would still be able to apply most useful corrections to his own instrument.

The method even of contemporaneous observations, unless continued for a great length of time, affords but very inaccurate results if the Barometers are at any considerable distance from each other, as will often be the case with a traveller in India.

Jaulnah, for instance, in February 1821, which from my own observations appeared to be (above sea) ... 1652

From contemporaneous observations. { By Colonel Lambton, at Hyderabad, „ ... 1661
„ Major Beckett, at Nagpoor, „ ... 1557
„ Mr. Goldingham, Madras Observ. „ ... 1747

and many more such instances might be given if there were time.

15. The preceding remarks refer chiefly to the formation of a rough profile of the country, and to the determination of altitudes at points distant ten or fifteen miles or more, and at a day's interval: the same rules or precautions however will equally apply to levellings carried on during one day only; but again, if with only a single Barometer they require to be made with rather greater precision, and all the necessary corrections to be carefully considered before they are applied, more especially those depending on differences of temperature and the hour of the day.

16. We have been noticing hitherto only the ordinary diurnal oscillations of the Barometer, or those partial and temporary irregularities which occur in the mean height at all seasons of the year, but the mean height of the Barometer varies also with the season of the year, and as the daily oscillations of the Barometer seem to be nearly independent of all local variations in the temperature of the air, so the monthly or quarterly changes in the mean pressure appear to be nearly independent of the monsoons or other mere local influences. The mean height of the Barometer in June, when it is lowest, is about one-third of an inch lower than in December and January, when it is highest.

These regular periodical fluctuations in the mean height of the Barometer, though nearly half a century ago made known by the celebrated traveller Humboldt, and by Doctor Balfour in the Asiatic Researches, and a few others, have only since a very few years occupied the attention of scientific men in Europe.

At Madras, in December 1818, Mr. Goldingham wrote me, "the principal use of the Barometer at the "Observatory is to correct the refraction; the other ob-"servations are subordinate: the hours of observation "are regulated more with regard to the Thermometer "than the Barometer."

17. Of late however numerous and most accurate observations have been recorded in every part of the world, more especially in connection with the Magnetic Observatories and the observations on tides, and have proved that the diurnal oscillations which have been so long known to exist within the tropics, are to be traced also in Europe with equal regularity, although much less in their extent.

The beautiful series of observations on this subject by Mr. Snow Harris, published in the 8th and 11th vols.

of the Reports of the Society for the advancement of Science, will be found to be well worth attention to all interested in these questions.

The preceding remarks on the application of the Barometer to levelling, have been drawn up rather from recollection than from any present examination and comparison of the many observations in my possession. It would have occupied much time to have gone into any such details, and although these rules in their present state make no pretension to great accuracy, they will, it is hoped, serve as some guide to those who may desire to prosecute such enquiries.

EXPLANATION OF THE RAIN TABLES.

1. At first Rain Registers were established at only five stations, although they were gradually introduced at the whole of the different stations indicated in the several columns of these tables: the crosses in red ink are to shew that no Rain Registers had at that date been established at those particular places.

2. The Rain Guages or Pluviometers were all constructed by myself of tin, with cork floats, and their index rods of deal wood: the funnels 8 inches diameter, the cylinders 4 inches, and the scale being divided in the same proportion, viz. 4 to 1: the quantities of rain were read off at once without requiring any reduction or correction.

3. The fall of rain was observed every morning about 6 A. M., and noted down for that date, although really the result of the preceding twenty-four hours.

4. The stations where the Pluviometers have been established, extend from the very extremity of the Peninsula at Cape Comorin, in Lat. 8° 4′ all along the Coast of Travancore and Cochin, as far as the town of Trichoor in Cochin, in about Lat. 10° 30′.

5. Five of these stations are immediately on the Sea Coast, or within a mile or two of it, viz.

Cape Comorin,	Allepey,
Trevandrum,	Cochin.
Quilon,	

		Miles	
One of them next to Cape Comorin	Nagercoil	is 6	inland.
Another, the farthest North	Trichoor	12	,,
Another, East of Quilon, and near the foot of the Ghats	Koraventavalum.	40	,,
Another, near Palghat	Chittoor	55	,,

6. Besides these nine stations on the Western Coast, there are three stations on the E. of the chain of Ghats in Tinnevelly, viz.—

One at Shencottah, near Courtallum, immediately at the E. base of the Ghats, and about 18 miles nearly due E. of Koraventavalum, or about 60 miles from the Sea Coast of Travancore.

Another at Palamcottah, which place is about 20 miles E. of the chain of Ghats, or 60 from the Western Coast, in the latitude of Quilon.

Another near Vaurioor, about 3 miles N. and a little E. of Cape Comorin.

7. Several gentlemen have kindly afforded their assistance in these observations:

1. At Vaurioor, the Register has been kept by the Rev. J. Russell, L. M. S.
2. At Nagercoil ..... Rev. C. Mault, „
3. At Koraventavalum ..... W. Huxham, Esq.
4. At Allepey ..... T. Crawford, Esq.
5. At Cochin ..... By the Dewan.
6. At Trichoor ..... Mr. Coelho.
7. At Palamcottah ..... Mr. Conductor Darling.
8. At the other places, by myself and by Native Assistants.

8. It is difficult to attempt explanation of the differences in the amount of rain exhibited in these tables at some of the inland stations, but as the great chain of Ghats, and the prevailing direction of the winds during the monsoon, must be supposed to have a material influence, I will offer a very few remarks on them.

9. The Wind is generally I think during the monsoon from the N. W., frequently W., and sometimes S. W., but the prevailing direction is I think N. W.: it is therefore almost invariably parallel to the line of Ghats, and as these are of great altitude, the rain may readily be supposed to be prevented from passing over them to the East.

10. The mass of Ghats which stretch for nearly 150 miles from Cape Comorin to Palghat, where they terminate abruptly in an almost perpendicular wall of 5,000 or 6,000 feet in height, occupy a triangular space, of which the base near Palghat is nearly 40 miles in length, the sides closing gradually towards their apex at Cape Comorin.

11. From Palghat to the latitude of Quilon their width may be from 20 to 30 miles, and they support I believe almost throughout that space a more or less continuous table-land of, I have reason to think, from 2,000

3,000 feet above the Sea, forming the great Cardamom act of Travancore with numerous chains, ridges, and eaks rising to an altitude of 5 to 6,000 feet above the ea, and probably also with considerable tracts of table-and of a proportionate elevation. There is, I understand, and at this Northern extremity of the Ghats as high as that of Ootacamund.

12. About the latitude of Quilon, the table-lands suddenly cease, the Ghats there consisting only of high parallel chains and ridges separated by deep narrow valies, and with several narrow necks or openings into the Tinnevelly District, elevated only about 1,000 or 1,200 feet above the Sea, and through which, into the District of Shenkottah or valley of Courtallum, the S. W. or more properly N. W. monsoon constantly escapes.

13. South of these necks or passes, of which Achencovil and Ariengaul are the most remarkable, the Ghats increase again in altitude, and support considerable tracts of table-land of not less than 4,500 feet above the Sea, most of the ridges and chains being about 5,000 feet, and several of the peaks at least 6,000 feet.

14. For the last 10 miles towards Cape Comorin, the Ghats break off altogether into separate groups and peaks of greatly diminished altitude, and offering no obstruction to the passage of the monsoon, were that its natural direction.

15. The obstruction that these high chains of mountains and so much high table-land must offer to the passage of the cloud masses of the monsoon, moving also nearly parallel to them, will be evident, especially when it is considered that the inferior stratum of cloud is not supposed to exceed above 4 or 5,000 feet.

16. There are however certain openings in the chain through which the monsoon does pass to certain extent, as already noticed, but that of Palghat is perhaps the most remarkable one from its great breadth of 30 miles clear, without a single hill or ridge to check the passage of the vapour.

The land rises almost imperceptibly from the Sea Coast of Ponany towards Polachi in Coimbatore, the elevation of which place is about 1,000 feet above the Sea, whence it declines again towards Caroor, on the Cauvery River, which is only about 500 feet above the Sea.

17. At Chittoor however, which is in the very midst of the opening and only 55 miles from the Coast, the fall

of rain is only about one-half of that at Cochin, or two thirds of that at Trichoor.

18. Shenkottah again in Tinnevelly is about 600 feet above the Sea, and about 8 miles on the E. side of the chain of Ghats, but the low passes already noticed of Achencovil and Ariengaul here connect it with the Province of Travancore, and through these the cloud masses are constantly passing during the months of June, July, August and September, with strong Westerly winds and a good deal of rain, producing the well-known delightful climate of Courtallum during that season. An almost constant canopy of cloud hangs over the Courtallum valley in those months, but it never extends above 10 miles E. of the Ghats. At a distance of 10 or 15 miles the wind is dry and hot, as at Palamcottah itself.

The subjoined are the results of observations on the Temperature, Dew Point, &c., for the month of August 1841, at Trevandrum, Courtallum, and in tents about 5 miles E. of Courtallum:

		9½ A. M.			4½ P. M.			Mean.	
		Temperature.	Dew Point.	Difference.	Temperature.	Dew Point.	Difference.	Temperature.	Dew Point.
1841	Trevandrum.....	80	74	6	83	74	9	81½	74
	Courtallum	80	71	9	81	72	9	80½	71½
August.	5 miles E. of Courtallum, 6 days' observations in tents.	83	68⅕	14⅘	85⅕	70⅗	14⅗	84	70
August 1843.	Palamcottah, 3 days' observations.	86	67	19	89	67	22	87½	69
„	Trevandrum.....	79	74	5	83	74	9	81	74

The fall of rain at Shenkottah is only about 40 to 50 inches, while at Koraventavalum, the same number of miles on the W. side of the Ghats, the fall is 100 to 120 inches.

19. From the proportion of rain at Chittoor, and observations on the Dew Points at Polachi in Coimbatore, and at Courtallum in Tinnevelly, in the monsoon months, I should suppose that the climates of both places are not very unlike.

20. The distance of Palamcottah from the Ghats, and the bare flat character of the whole District, may sufficiently account for the small quantity of rain that reaches that station from the Malabar monsoon: its position also, so near the extremity of the Peninsula, and the diminished altitude and contracted mass of the Ghats as they approach Cape Comorin, breaking and thinning off into narrow detached peaks and ridges, offering no barrier or obstruction to the passage of the monsoon vapour, may explain not only the diminished fall of rain at that place from the N. E. or Madras monsoon, but also the small amount of rain at Vaurioor and at Cape Comorin, which are equally open to both the monsoons.

21. In regard to the accuracy of the form of Rain Guage here made use of, it is believed to be the one most generally adapted, and the whole of them being alike, it will be easy to apply any correction that may hereafter be deemed proper: a small additive correction may be considered desirable on account of the weight of the cork float and rod, and perhaps from ·03 to ·05 inches may be a proper correction to be added to each day's rain. I have placed one of these Pluviometers since the 1st of January last adjoining that attached to the Anemometer and Tide Observatory at Cochin, and the following are the results:

1844	No. of days' rain.	Quantity in the Observatory Pluviometer.	No. of days' rain.	Quantity in Gen. Cullen's Pluviometer.
January	1	0·140	1	0·100
February	1	1·112	1	1·005
March.....	5	1·301	3	0·605
April	6	3·978	6	4·002
May.....	23	22·111	21	23·589
June.....	30	25·040	30	22·460
	66	53·682	62	51·761

MEMORANDUM.

The Aneroid is an excellent substitute for the ordinary Mercurial Barometer from its extreme portability, though not perhaps quite so accurate. I believe I was the first to record comparative observations with the two Instruments, at a great altitude on Dodabett, in August 1852, and afterwards published in the Journal of the Madras Literary Society. (See Madras Literary Journal, No. 39, January to June 1851, page 155.) In the following year or year after, Colonel A. Cotton was so much interested in this little pamphlet on Barometrical and Aneroid levelling, which had been shewn to him by Capt. Horsley, that he requested that officer to procure for him from General Cullen 12 copies, to distribute amongst the officers of Engineers, and which were duly furnished to him.

MEMORANDUM BY COLONEL CULLEN ON THE SUPPLY OF WATER TO MADRAS.

Memo. from Barometrical Observations made in 1831—2—3; a copy of which was sent to Mr. A. Maclean, the then Collector of Chingleput.

It has always appeared to me practicable to procure a stream of fresh water from some of the neighbouring small Rivers for the supply of the population of Madras—not perhaps in very great quantity, yet sufficient to render the enquiry an object of considerable interest. The course of the Cooum is short, and its bed is nearly dry a great part of the year, yet possibly (for even at this moment after 3 or 4 years' continued drought there is water within 4 or 5 feet of the surface 3 miles W. of Madras,) a small stream might be taken off it 4 or 5 miles to the Wd. during several months.

The Adiaar, although generally with a stream in it throughout the year, is perhaps too far to the Sd. to be of benefit to its immediate vicinity, but it is probable that a cut might be taken off it above Sidapett to the N. or Wd. of the Mount, which would afford a very considerable stream a great part of the year for the supply of the Long and other Tanks, and it might even perhaps be carried on to St. Thomé or Triplicane. It has also appeared to me that it might advantageously be applied to the irrigation of Guindy Park, as I mentioned to Mr. Chamier. There is however another River, the Cortillyaar, which although rather more distant, might I think be easily connected by a Canal with the great Tank at the Red Hills, and thence afford a steady supply to Madras for domestic purposes, if not for the cleansing of the Town.

The great Tank or Lake at the Red Hills is a noble sheet of water when full, and capable of watering an extent of ground which yields to Government, in favorable seasons, a clear annual revenue of 9,000 or 10,000 Rs., yet from having been perfectly dry for the last 3 years, has yielded nothing.

It seemed possible to bring on a stream of water from this Lake to Black Town and its suburbs, if a communication could be established between the Lake and the Cortilly River, so as to replace the expenditure.

There is a fine body of water in the Cortilly at Yermootapolliam, and the bed of the river there appears to be above that of the Red Hill Lake, but the intermediate ground is rather high, perhaps about 40 feet.

An examination however of the country to the S. W. of the Red Hills, shewed that there was not only an opening or hollow through them to the Wd., but that there had formerly existed a splendid Canal in that direction, apparently for the express supply of this Lake and the other smaller Tanks along its course. This Canal, in many parts still quite perfect, extends from the Red Hill Lake by the village of Vellanoor to Vellachery, a total distance of not less than 8 miles. It is of noble dimensions for a native work, being generally 30 to 40 feet wide, and in some parts, particularly to the W. of Vellanoor where it crosses a swell, not less than 10 or 12 feet deep.

Vellachery is on the Wn. slope of the long swells, forming what are called the Red Hills, which after running a few miles farther S., then trend round to the Wd., forming a kind of amphitheatre of gently sloping ground to a great extent round Vellachery, and rendering the vicinity of Vellachery itself, and the country for many miles to the W., a perfect swamp. The Canal seems to have been intended to carry off the superfluous water from this tract to the Red Hill Lake, and other reservoirs to the Ed.

Lieut. Green, in December last, sent an estimate for opening a communication between Vellachery and the Red Hill Lake, amounting to 2,800 Rs., but no notice is taken in that report of the existence of this ancient Canal, nor to that of many portions of it being still filled with water, though from the small amount of the estimate, some such circumstances might be presumed. He has probably estimated only for a narrow cut in the middle of the old channel.

At present however there is no stream of water to be obtained even at Vellachery, and it seemed desirable therefore to ascertain how high up the Cortilly River, it would be necessary to go to obtain a supply.

A reference to the Map might suggest the neigh-

bourhood of Vellepaukum, but it proves to be considerably below the level of Vellachery.

The next place that suggested itself was Tiroovalum Boodoor, about 12 miles nearly due W. of Vellachery, and this spot seems to be admirably calculated for the purpose, not only from its high level, 110 feet above the sea, but from the existence of a chain of narrow slips of water extending over nearly one-half of the intermediate space.

The whole interval from Tiroovalum to Vellachery is nearly a dead flat and swamp, and these long pieces of water bear strong marks of being the remains of a Canal which, probably originating from the Cortilly River near Tiroovalum, extended to Vellachery. Nothing therefore seems now to be necessary but to re-open or connect this line of backwaters with the Cortilly River and Vellachery, to obtain a constant and abundant supply for the whole of the reservoirs over a tract of 25 or 30 miles of country.

The expense could not be great, for the soil is easy to excavate, and there are no elevations of consequence. The Engineer has already stated that the expense of re-opening the communication from Vellachery to the Red Hills, an interval of 8 miles, will not exceed 2,800 Rs., supposing that it were necessary to cut the whole distance (12 miles) from Tiroovalum to Vellachery, say 9 feet broad and 4½ feet deep, the expense would not probably exceed 20,000 Rs.; but, as has been observed, there is already deep water over a considerable part of that interval.

or the water might be conveyed by pipes from the Red Hill Lake to keep it clear from the Marine alluvium.

There would then only remain therefore a cut to be made of 6 or 8 miles towards Madras.

The Cortilly River at Tiroovalum, in January 1833 last, had but a very small stream of water in its bed, but the extraordinary drought that has now prevailed for 3 successive years must not be forgotten. Tiroovalum is just below the junction of the Cortilly River, with a small° mountain stream, and both of them must, from the rapid ascent that thence takes place to the W. from the proximity of the mountains, fill with every shower of rain. These waters, which now run off to the Sea, without being of any advantage to the country below Tiroovalum, might be thrown into the Canal, and every drop of it turned to account; for, as has been noticed above, the whole of these tracts are saturated with moisture, and there would be no less by absorption. The slope of the country too is favorable to a full flow of the water, being no where

° In Lieut. O'Connell's schome, the aid of the stream from Placepett is ~~neglected~~ omitted

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less apparently than from 3 to 4 feet per mile on a direct line.

It has been stated that the grounds watered by the Tank at the Red Hills yield, in favorable season, a revenue of 9,000 Rs. per annum. During the last 3 years, the loss of revenue has been about 20,000 Rs. During the last 12 years, a total loss of not less than 35,000 Rs., a sum of itself alone nearly sufficient perhaps to have defrayed the expense of the projected Canal, but when it is recollected that land is at least doubled or tripled in value by an efficient system of irrigation, [Mr. Sullivan in his evidence before Parliament, states that the relative increase of assessment in Coimbatore upon irrigated over-dry land is, as 6 to 1,] the importance of the subject becomes still more apparent. The British have done little, it appears to me, towards improving or extending irrigation under this Presidency. They have barely kept in repair the works which they already found in existence; but, as observed by Mr. P. Gordon, Mr. Chaplin, and many others, in their evidence before the House of Commons, while the enormous sum of from 4 to 600,000 Rs. is annually expended in the *repair* alone of such works, little or nothing is done towards the extension of irrigation; few new works are projected or executed; the numerous and splendid remains of ancient ones, which abound in almost all parts of our territories, are neglected and going to decay. It might not be without utility were the Officers of Revenue called upon for a statement of all such works still in existence in their several districts, but which are neglected, and in a state of decay.

Equal to the construction of such a Canal as I have suggested in this paper of 144 miles in length.

Before concluding this paper, it may be proper to point out another part of this District which I passed through in 1832, where a Canal would seem practicable and useful, viz., to be taken off the Palar River, near Pandoor, about 6 or 8 miles from its mouth. A very considerable tract of country to the S. W. of Sadras might then be irrigated. The land is now, it is believed, neglected and useless, and the water of the River runs off to the Sea.

To

His Excellency The Honorable
Major-General Sir THOMAS MUNRO, K.C.B.,
Governor in Council.

HONORABLE SIR,

We have the honor to report that Captain Cullen, of the Corps of Artillery, Commissary of Stores in the Ceded Districts, who was appointed in the month of June 1817, to affix Tangent Scales to the whole of the Brass Ordnance under this Presidency, has completed the duty upon which he has been employed, and we have now to state that the number of Guns which have been furnished with Tangent Scales, amounts to 644.

3. From Captain Cullen's account, it appears that after quitting the Presidency, he travelled 3,900 miles; in doing which, and in completing 448 guns at the Out-Stations of the Army, he has occupied 3¼ years. He calculates the period employed in marching at 12 months, and in completing the work on which he was engaged at 27 months, which is at the rate of 16⅓ guns per mensem.

4. We beg to express our entire satisfaction with the conduct of Captain Cullen, since he has been so immediately under our orders, and to bear testimony to his zeal and talent in the execution of the duties now reported to be completed.

Fort St. George, 5th March, 1822.

Extract from the Minutes of the Honorable the Governor in Council, dated 26th March, 1822.

The Governor in Council notices with satisfaction the favorable testimony of the Military Board, in regard to the zeal and talent with which Captain Cullen, of the Artillery, has performed the duty of fixing Tangent Scales to the Brass Ordnance of this Presidency.

(True Extract.)

(Signed) THOS. MACLEANE,
Secy. M. Board.

To

Captain CULLEN,

of the Artillery.

SIR,

Para. 1st. I have had the honor to receive your letter of the 29th Ultimo, with 3 Sections through the Peninsula, taken in different directions, and constructed from your Barometrical observations.

I consider these to be very valuable documents in this Department, and in offering you my own thanks for them, I beg to assure you, that I shall lose no time in bringing them to the notice of Government, through the Revenue Board.

I have the honor, &c.,

(Signed) T. F. D'HAVILLAND,

Major, Inspr. Genl. of Civil Estimates.

Madras, 2d April, 1822.

Extract of a Letter from Mr. Secretary HILL, *to the President and Members of the Board of Revenue, under date* 30*th April,* 1822.

I am directed to acknowledge the receipt of your Secretary's letter of the 11th Instant, (172) accompanied by a series of levels taken by Captain Cullen, of the Artillery, from Barometrical observations. The subject is considered by the Governor in Council particularly interesting, and that Officer's attention to it highly meritorious.

(True Extract.)

(Signed) T. F. D'HAVILLAND,

Major, Inspr. Genl. of Civil Estimates.

Extract of a Letter from the Secretary to Government in the Military Department, to the Military Board, dated 2d November, 1830.

The Right Honorable the Governor in Council has much pleasure in observing the favorable result which has attended the adoption of Lieutenant-Colonel Cullen's arrangements and suggestions, respecting the felling and removal of timber from the Mysore Forests to Seringa-

[redacted]tam, by which a saving of 1,41,517 Rs. to the Government has been effected within the last five years, and he will not fail to bring the zealous and honorable exertions of that intelligent Officer to the notice of the Hon'ble the Court of Directors.

(True Extract.)

(Signed) H. MOBERLY,
Actg. Secy. Mily. Board.

Extract from the Minutes of Consultation, dated 26th November, 1830.

Resolved,—That the alterations proposed to be made in the loads of Carts employed in conveying Public Stores from station to station be approved, and that the Military Board be directed to submit the Draft of a G. O. for carrying them into effect.

The practicability of increasing the loads of Carts having been suggested and approved by Lieut.-Colonel Cullen, the Government record their approbation of the continued exertions of that Officer to promote the interests of the Public Service.

The Right Honorable the Governor in Council will be glad to receive a further report of the new pattern Store Cart, proposed to be introduced by Lieut.-Colonel Cullen, after it shall have been submitted to a proper trial.

(True Extract.)

(Signed) H. MOBERLY,
Actg. Secy. Mily. Board.

No. 60. Ordnance Department.

To

The SECRETARY to the
Military Board.

SIR,

Should any portion of the copies of the large Map of India, recently sent out by the Court of Directors for distribution to Public Officers, still remain unappropriated, may I hope the Board will do me the honor to suggest a copy being furnished for my use as Principal Commissary of Ordnance, &c.? In communication with every station of the Army in regard to the despatch and receipt

of Ordnance Equipments, independent of various oth[illegible] enquiries with which the Board have entrusted me, the[illegible] will I hope approve of my application.

I have the honor, &c.,

(Signed) W. CULLEN, Lt.-Col.,
Principal Commy. of Ordnance.

Arsenal, Fort St. George, 10th February, 1832.

No. 46. Military Board Office.

To

The Right Honorable S. R. LUSHINGTON,
Governor in Council.

SIR,

In submitting the accompanying copy of a letter which has been addressed to us by Lieut.-Colonel Cullen, Principal Commissary of Ordnance and Superintendent of the Gun Carriage Manufactory, applying for one of the new Maps of India which are under supply, (in parts,) by the Honorable Court of Directors, we have the honor to observe, that in his official capacity we do not consider it to be at all essential that Lieut.-Colonel Cullen's request should be complied with. As an Officer, however, who has frequently been honored with the notice of Government for his general scientific pursuits, particularly for the interesting series of levels over different parts of the Peninsula, presented (we believe) through the Inspector General of Tank Estimates, &c., in 1821, and for his subsequent enquiries and reports relative to the conveyance of Timber by the Toongabuddra river to Bellary, and by the Cauvery from Mysore and Palghat, &c., to the Eastern Coast, his reports relative to the forests of the Western Coast, and other useful and valuable Topographical Information, we trust we shall be excused in taking the liberty of suggesting that, if one of these Maps can be spared without inconvenience, it may be awarded to Lieut. Colonel Cullen, as a mark of the value which Government place upon his researches into subjects of general and useful information.

We have the honor, &c.,

(Signed) W. G. PEARSE,
" D. SIM,
" W. STRAHAN,
" B. R. HITCHINS.

Fort St. George, 14th February, 1832.

Military Department.

Extract from the Minutes of Consultation, 28th February, 1832.

Read the following Letter from the Military Board.

(Here enter 14th February, 1832, No. 46.)

The Right Honorable the Governor in Council sanctions the loan of a copy of the new Map of India to Lieut. Colonel Cullen, (if one can be spared without inconvenience,) in consideration of the valuable Topographical information which he has afforded to the Government, and not as a record essential to the proper discharge of his official duties.

(A true Extract.)

(Signed) ROBERT CLERK,
Secy. to Govt.

To The PRESIDENT and MEMBERS of
The Military Board.

Military Board Office.

To

Lieut.-Colonel CULLEN,
Supt. Gun Carriage Manufactory.

SIR,

Referring to a letter from this Office, bearing date 7th December, 1830, on the modification of loads for Country and Platform Carts conveying Stores from station to station, recommended by you, I have the honor, under the orders of the Military Board, to transmit copy of an Extract from a General Letter from the Honorable the Court of Directors on the subject, and to request you will be pleased to favour them with your opinion as to the practicability of a still greater reduction being effected in the Cattle appropriated to purposes of Transport.

I have the honor, &c.,
(Signed) THOMAS MACLEANE,
Secy. M. Board.

Fort St. George, 22d January, 1833.

Military Department.

Extract from a General Letter from the Hon'ble the Court of Directors in the Military Department, dated 25th July, (No. 58 of 1832.)

1 to 7. Report a revision of the Regulations under which Cattle have been allotted to heavy and light Ordnance. This measure, by materially reducing the number of Cattle employed, will effect a saving of expense, in the Hyderabad and Nagpore Subsidiary Forces alone, of above Rs. 40,000 per annum.

8 and 9. Report the adoption of a proposition made by Lieut.-Colonel Cullen, for increasing the loads of Carts employed in the transport of Stores. The weight hitherto allowed is to have reference only to actual Field Service; by the new allotment, it is expected that a saving will be effected in the transit of Stores from station to station to the extent of Rs. 20,000 per annum, being nearly ⅓ of the actual expenditure. An improved Store Cart, proposed by Lieut.-Colonel Cullen, will be reported on.

Para. 24. We much approve of these Proceedings, and entertain a due sense of the valuable services rendered to the State by Colonel Cullen, in having suggested the propriety of reducing the number of Draft Cattle formerly employed in the transport of Ordnance & Public Stores.

25. Experience will enable you to decide whether a still greater reduction of the Draft Cattle, appropriated to purposes of Transport, may not safely be made, as suggested by Colonel Cullen.

(True Extract.)

(Signed) ROBERT CLERK,
Secy. to Govt.

To The PRESIDENT and MEMBERS of
The Military Board.

(A true Copy.)

(Signed) THOS. MACLEANE,
Secy. M. Board.

Military Board Office.

To
Lieut.-Colonel CULLEN,
Late Principal Commy. of Ordnance, and
Supt. Gun Carriage Manufactory.

SIR,

The Committee of the Military Board, which lately examined the Arms and Accoutrements in Store, at the

Arsenal of Fort St. George, having noticed in high terms that the regularity which pervades in every Department of the Arsenal, the high state of preservation of the Arms and Accoutrements, the method and order in which the several Store Houses are kept, reflect the greatest credit on the zeal and ability evinced by you, in the exercise of the various duties entrusted to you, and the same having been brought to the notice of Government by the Military Board, I have the honor, under their orders, to forward copy of an Extract of Minutes of Consultation passed thereon.

I have the honor, &c.,
(Signed) THOS. MACLEANE,
Secy. M. Board.

Fort St. George, 21st May, 1833.

Military Department.

Extract from a General Letter from the Hon'ble the Court of Directors in the Military Department, dated 3d July, No. 59 of 1833.

Extract from the Minutes of Consultation, 10th Jany. 1834. Ordered that copies of these Paras. be furnished to the Military Board, with instructions to prepare the necessary models for transmission to Bengal.

1. We have repeatedly forbidden alterations in the important Department of the Ordnance without our previous sanction, and have therefore to express our disapprobation at the changes in the construction of Gun Carriages, noticed in the letters of 20th Dec. 1831, No. 36, and 10th July 1832, (No. 21,) quoted in the margin.

Letter from (No. 36) dated 20th Dec. 1831. Paras. 35 & 36. Reporting that sanction has been given for the general, but gradual introduction of 2 Plans of Lt.-Col. Cullen, the Supt. of the Gun Carriage Manufactory, which had been approved of by the Select Artillery Committee; one for simplifying the Axletrees & Naves of Gun Carriages, and the other for dispensing with solid Beam Trails, in the construction of heavy and light Field Carriages. Also reporting the gradual

2. The variety of patterns in Ordnance Carriages and Equipments at the three Presidencies, and the difference in many other essential points where uniformity is most desirable, is attended with disadvantages to the Public Service more than commensurate with any benefit to be expected from partial or local systems even of improvement, and may prove a source of serious evil.

3. The difficulty of procuring Timber suitable for solid Beam Trails, claims on the plea of necessity our sanction to the purposed change, as regards the light 6 Pounders and Howitzer Carriage; but as no reason has been assigned, much less any substantial objection urged

adoption of wooden beds for 8 and 10 inch Mortars.

Letter from (No. 21) dated 10th July 1832. Para. 25. Forwarding models of the Gun Carriage in use at Madras, and soliciting attention to a letter from the Military Board, noticing improvements in the construction of Carriages, by the discontinuance of the solid Beam Trails, and bearing testimony to the zeal and ability of Lieut.-Col. Cullen, Supt. of the Gun Carriage Manufactory, who originated the improvement.

against the check carriages of heavy Ordnance hitherto in use, we see no sufficient motive that should have induced you to alter that pattern.

4. The attainment of uniformity in the general outline of appearance with the light 6 Pounder Carriages, aided even by improvements in some respects, does not in our opinion form any adequate ground for alteration.

5. It would appear from the comparative Trial of the Travelling qualities of the Bengal 18 Pounders, and the proof of Firing, as noted in your reports, that this carriage stood equally well with that of Madras; here, then, was an opportunity, if change was necessary, to assimilate with the Bengal pattern, which would have been extending the desired object of uniformity to a usual end.

6. When, therefore, alterations are imperatively called for, we have decided they should be made with reference to the gradual introduction of one general system throughout India, rather than to any local views of improvement.

7. We desire that you will suspend the further construction of Carriages upon Lieut.-Colonel Cullen's principle for heavy Ordnance, and that you communicate with the Bengal Government upon the change it involves; furnishing working models of the 18 Pounder Carriage, and the two others to which the alterations apply.

8. We shall convey our own sentiments to the Supreme Government regarding them, with reference to the views we entertain of assimilating the Ordnance Department of the Service generally, but gradually, and only when circumstances call for change.

9. The simplification of the Axletree Arms and Naves of Gun Carriage Wheels, tending to limit the different kinds hitherto in use, meets with our approval.

10. The gradual introduction of wooden beds for 8 and 10 inch Mortars, appears to be desirable, as rendering you so far independent of supply from this country.

11. The models of Gun Carriages, forwarded per Ship "Madras," from your Presidency, have been duly received.

12. Though we have thus commented upon most material alterations, which should never have been introduced without our previous sanction, we are not the less

[s]ensible of the zeal and merit of Lieut.-Colonel Cullen, as brought to our notice in the present proceedings.

(True Extracts.)

(Signed) R. CLERK,
Secy. to Govt.

To The PRESIDENT and MEMBERS of
The Military Board.

Extract from a Letter from the Hon'ble the Court of Directors in the Military Department, dated 24th October, No. 82 of 1832.

29. We have in a previous letter, (18th June 1828, Para. 86,) expressed our satisfaction at the zeal and good management displayed by Colonel Cullen, whilst acting as Superintendent of the Gun Carriage Manufactory at Seringapatam.

30. We continue to entertain a due sense of his valuable services.

(True Extract.)

(Signed) R. CLERK,
Secy. to Govt.

(A true Copy.)

(Signed) H. MITCHELL,
Actg. Dy. Secy. M. B.

Political Department.

Extract from a General Letter from the Hon'ble the Court of Directors, dated 12th August, No. 4 of 1835.

Proceedings relating to Vellore Stipends.

Para. 4. These letters convey to us the satisfactory intelligence of your having effected a considerable retrenchment in the expenses connected with the payment of Stipends at Vellore.

5. You have, in the first place, abolished the Office of Paymaster of Stipends, the duties of which are henceforth to be discharged by the Officer Commanding Velloro,

Extract from the Minutes of Consultation, dated 9th Feby. 1836.

Ordered that copies of these paras. be furnished to Lieut.-Cols. Cullen & Stewart respectively for their information.

with the aid of the Fort Adjutant at that place. By th[illegible] arrangement, the whole salary of the Paymaster will [illegible] saved. Of this saving, one-half only will accrue to your Government; half the salary having been a chargé on the Government of Ceylon.

6. You have further appointed a Committee to report on the various expenses of the Office, and on the reductions which might be practicable. The Committee reported that the Office Establishment was unnecessarily large, and the servants attached to it too highly paid; that an unnecessary number of attendants were kept up at the Mehals, in which the families of Hyder Ally and Tippoo Sultan reside; that the Rahtibs, or daily provisions allowed to the families were procured at an unnecessary expense, and that various other abuses existed. The Establishment of the Office has, in consequence, been placed on a greatly reduced scale; of the superfluous servants attached to the Mehals, some have been discharged, and the places of others are not to be filled up: the articles supplied to the Mehals are hereafter to be obtained by contract, under proper securities, and the other abuses which were brought to your notice by the Committee, have been reformed. The result is, a considerable immediate and a larger prospective saving, for which the Officers composing the Committee, Lieut.-Colonels Cullen and Stewart, are entitled to commendation.

(True Extracts.)

(Signed) H. CHAMIER,
Chief Secretary.

To Lieut.-Colonel CULLEN.

Military Department.

Extract from a Letter from the Hon'ble the Court of Directors, dated 8th June, 1836, No. 42.

No. 3154. Extract from the Minutes of Consultation, 18th October, 1836. Ordered that copies of these parns. be furnished to the Military Board &

Para. 17. We have carefully examined the Propositions here submitted to us. We fully approve them, and desire that they may be carried into immediate effect, in the manner, and with the modifications proposed in Sir Frederick Adam's Minute, dated 12th May, 1835.

14. State that after a careful examination into the present state of the Ordnance Department, a revised allotment of Warrant & Non-Commissioned Officers

Attached to Arsenals has been determined on, and is submitted for Court's consideration and approval.

18. We desire that you will convey to Colonel Cullen our warm approbation of the zeal and intelligence manifested by him in submitting to Sir Frederick Adam the very valuable information, of which your Government has so properly availed itself.

(True Extract.)

(Signed) S. W. STEEL, Lt.-Col.,
Secy. to Government.

To Lieut.-Colonel CULLEN.

to Lieut.-Colonel Cullen.

The Board observe that orders have been passed to give effect to the instructions of the Hon'ble Court contained in these paras. in an Extract from the Minutes of Consultation, No. 3145 of this date.

Military Department.

Extract from a Letter from the Hon'ble the Court of Directors, dated 21st February 1838, No. 17.

2 and 3. With the view of giving encouragement to the breeding of Horses, and of introducing superior race of Horses in the Territories under the Madras Presidency, Government have, at the suggestion of the Commissary General, granted authority for 10 Mares being commissioned from the Cape of Good Hope, and for the purchase of 25 or 30 Kuttywar, Cutch and Khorassan Mares, to be distributed in the Coimbatore District, and the most eligible parts of Mysore.

16. We have perused with much interest, the very intelligent and able report by the Commissary General, Col. Cullen, on the present prospects of the Establishments for breeding Horses in the Coimbatore, Bellary and Cuddapah Districts, and we trust that, under his continued superintendence, very satisfactory results may be expected.

17. The resolution you have adopted, on Colonel Cullen's suggestion, for procuring a small number of Brood Mares for distribution in the Breeding Districts, has our approbation.

18. In our Military letter to Bombay, of the 12th July, 1837, when replying to the Proceedings of that Government, with a view to a supply of Horses from the Cape of Good Hope, we have made the following remarks, which are equally applicable to your Presidency: "Should the experiment succeed in this "case, you will not on that account relax "in your endeavours to obtain the annual remount from "sources under your own control, or under that of the "Government of India."

No. 2465.

Extract from the Minutes of Consultation, 24th July, 1838.

Ordered that these paras. be communicated to His Excellency the Commander in Chief and Commissary General, in reference to an Extract from the Minutes of Consultation, dated 7th Feby. 1837, No. 499.

" We are happy to observe, that the annual out-turn " of Colts from the Studs in Bengal, now amounts to 11 " or 1200, with a prospect of increase, and we cannot but " hope, that with due encouragement of these Studs, of " that at Alligaum under your Government, and of the " Mysore Breeding Establishment, the whole wants of " the mounted Corps of the three Presidencies may be " effectually and economically supplied."

Military Department.

Extract from a Letter from the Hon'ble the Court of Directors, dated 14th March 1838, No. 28.

No. 2065. Extract from the Minutes of Consultation, 12th June, 1838. Ordered that a copy of these paras. be furnished to the Commissary General, in reference to an Extract from the Minutes of Consultation, No. 698, under date the 28th of Feby. 1837.

4. We learn from this report that one cause of the large expense of feeding Elephants at Secunderabad, in the year to which we had referred, (1833) was the scarcity which then prevailed, and that in subsequent years, by the reduced cost of food, and by increased attention on the part of the Officers of the Commissariat, the expense of feeding Elephants had been reduced at this station from Rs. 142 3 each per month, the cost in 1833, to Rs. 26 6, the cost in 1836. We also learn that the average cost of feeding Elephants on your Establishment had been reduced in the year 1836 to Rs. 19 11, and of Camels to Rs. 4 8 10 per month. These results are satisfactory and highly creditable to the Officers of the Commissariat.

6. Forward a Report received from the Commissary General, on the subject of the mode and expense of keeping & feeding Elephants and Camels.

5. The expense of attendants on Elephants and Camels at your Presidency is, we observe, more than double that in Bengal, but as the zealous attention of your Commissary General and his Assistants is now given to this item of expense, we are persuaded that every reduction which is compatible with the efficiency of the Service will be speedily effected. We shall be desirous of receiving continued reports upon this part of the subject.

Ordered that copies of these paras. be furnished to the Medical Board & to the Commissary General.

8. In your letter of the 21st Sept. 1832, you observed, "that in the first six months of the year 1827, immediately succeeding the abolition of the Contract held by Medical Officers for the supply of Wine and other necessaries to the sick,

21. Government forward the report of the Commissary General on the expenditure of Wine, &c., in the European Hospitals.

the expenditure of Wine, Spirits and Beer had increased to a very remarkable extent.

9. We have now been furnished with the Reports of the Medical Board and the Commissary General, made in consequence of the desire expressed in our Military letter of the 2d October 1833, that a most rigorous enquiry might be instituted into this important matter.

10. The Medical Board admit that the consumption of Wine and Spirits in many of the European Hospitals was on the first change of system in the year 1827, more than was absolutely necessary, but they state that the consumption has since been greatly reduced, and that in several of the Hospitals in the year 1833, the expenditure was less than when the supplies were furnished at the expense of the Surgeon.

11. The Report of the Commissary General shews clearly that the expenditure on this account was in the aggregate for a considerable time after the change of system, extravagantly great. Even during the last six years, a reduction of upwards of 50 per cent. has been made in the cost of Wine, &c., without any interference with the real wants of the sick.

(True Extracts.)

(Signed) S. W. STEEL, Lt.-Col.,
Secy. to Government.

To The COMMISSARY GENERAL.

No. 40. Political Department.

To

His Highness MARTANDA VURMAH,
Rajah of Travancore.

Para. 1. I have received with deep regret the melancholy intelligence of the demise of your Highness' Brother, Rajah Sree Padmanab Doss.

2. The removal of this accomplished Prince, in the prime of life, has I doubt not, plunged the whole family into the deepest grief, and on this melancholy occasion it is the desire of Government to offer its condolence, especially to yourself and to Her Highness the Ranee.

3. As the Heir to the Throne, you will now have to enter upon those important duties, which, in consequence

of the lamented death of your Brother, will devolve upon you.

4. To assist you in the discharge of these duties, your Highness will have the counsel and advice of Major-General Cullen, the British Resident at your Court, and you will do well to place every confidence in an Officer, whose great energy and talents are devoted to the advancement of your Highness' interests, the happiness of your people, and the mutual welfare of both the British and Travancore States.

5. In the hope that your Highness may make it the study of your life to promote the prosperity of your subjects, and to preserve your honorable connexion with the British Government, I offer you my cordial congratulations on your succession to the Musnud. I have instructed the Resident to deliver to you suitable presents on the occasion, and my sincere desire is, that your reign may prove a happy one, and of long duration.

What can I say more?

(Signed) TWEEDDALE.

(A true Copy.)

(Signed) J. F. THOMAS,
Chief Secretary.

Fort St. George, 28th January, 1817.

No. 26. Political Department.

To

His Highness MARTANDA VURMAH,
Rajah of Travancore.

I have received your Highness' obliging letter of the 4th Instant, expressing your hope of the continuance of the consideration and regard which has been hitherto shown to you by the British Government, and of its solicitude for the interests and prosperity of your Highness' country.

2. It is gratifying to me in this farewell letter to record my assurance that the distinguished Officer who is to succeed me will give every needful care and attention to the welfare and prosperity of your country, which I feel confident your Highness will best ensure by continuing to be guided by the counsel and advice of Major-General Cullen, who has proved himself to be so deserv-

ing of your confidence, by his zeal, and the ability he has displayed in suggesting and assisting your Highness in effecting improvement in every Department of your Sircar.

What can I say more?

(Signed) TWEEDDALE.

17th January, 1848.

(True Copy.)

(Signed) J. F. THOMAS,
Chief Secretary.

To The RESIDENT of
Travancore and Cochin.

From the Hon'ble Court of Directors' Letter, 20th May 1846, *on General* CULLEN'S *Paper on Museums, Barometrical Levelling, Rain Guages, &c.*

We have read with interest the remarks of Major-General Cullen on Barometric levelling, which appear to be sufficiently accurate to supersede, in many cases, the more lengthened process of surveying the ground, and in all cases to be desirable as a preliminary process.

We therefore approve of the proposition for combining, with the other objects of the local institutions, the register of a fixed Barometer, which will afford a standard of comparison for those used in the field; and we also think a like register of the Rain Guage to be very desirable; as Systematic Meteorological Observations were directed to be kept in the Observatory at Madras, a permanent Standard Barometer would necessarily be there.

(True Extract.)

(Signed) R. G. CLARKE,
Depy. Secy. to Govt.

To Major-General W. CULLEN.

[These Papers, and General Cullen's Barometrical Sections, having been presented by the Court to the Royal Asiatic Society, General Cullen was immediately elected an Honorary Member of the Society.]

The attention of the Board of Revenue, in the Department of Public Works, is particularly directed to the observations contained in paras. 18 to 24 of General Cullen's Memo. on Barometrical levelling, with a view to their carrying out the Orders of the Hon'ble the Court in this para.

Ordered, That paras. 10 to 14, with the foregoing Resolutions, be communicated to Major General W. Cullen, with reference to his several letters on the subject.

Extract from Minutes of Consultation, No. 488 *of* 18*th May* 1849. *On Major-General* CULLEN'S *Report on the Influence of Trees on Climate and Rain.*

See Journal of Madras Literary Society, No. 36 of 1849.

The Right Honorable the Governor in Council resolves to furnish Major-General Cullen a copy of the foregoing Proceedings, and to convey to him at the same time the thanks of the Government for his valuable and interesting communication.

(Signed) H. C. MONTGOMERY,
Secy. to Govt.

No. 21. Political Department.

To

Lieut.-General CULLEN.

SIR,

I am directed by the Honorable the Governor in Council, to acknowledge the receipt of your letter of the 24th Ultimo, and of its enclosures, viz., a Memorandum of your Services, and of the various orders in approval of your conduct and exertions, which have from time to time been recorded by the Honorable the Court of Directors, by Government, or by the subordinate authorities, during your long official career; as, also, a copy of the Reports made by you to Government on Museums, Barometrical Levellings, and Rain Observations, and on the Irrigation of the Bellary District from the Toombuddra, and practicability of opening by means of that river a water communication from the Western Ghats to the Eastern Coast, with suggestions for the better supply of Madras with water.

2. I am desired to convey to you the thanks of Government for these Papers. The Reports, as well as your own very honorable testimonials, are for the most part already on the records of Government; but the Honorable the Governor in Council has much pleasure in receiving them in this collective form; bearing, as they do, such evidence to your scientific attainments, and to your desire to promote the improvements of the country throughout your long and varied service.

I have the honor to be,
Sir,
Your most obedient Servant,
(Signed) T. PYCROFT,
Chief Secretary.

Fort St. George, 11th January 1860.

LIEUTENANT-GENERAL CULLEN

1. Was educated for the Artillery, at the Royal Military Academy, Woolwich.

2. Left Woolwich in June 1803.

3. Arrived at Madras in July 1804.

4. March 1805. Marched to join the Hyderabad Subsidiary Force in Candeish.

5. December 1805. Attached with two guns to the 2d Regiment of Cavalry, and 7th Regiment Native Infantry, in pursuit of a Pindaree Leader, named Soobh Kurreem. Four guns, with their camp and baggage taken, and many killed.

6. February 1806. In consequence of a severe illness, caused by the foregoing Service, left on Sick Certificate to Madras.

7. In Autumn, 1806, appointed Adjutant of the 2d Battalion Artillery.

April 1810. Promoted to Captain, and joined the Expedition against the Mauritius. Present at the attack and capture of St. Denis, the capital of Bourbon, in July 1810. Appointed Commissary of Ordnance, and to the command of the Artillery at Bourbon.

8. Returned to Madras in January 1812.

July 1812. Joined the Company of Artillery at Seringapatam.

July 1814. Appointed by Lieutenant-General The Hon'ble Sir John Abercrombie, Commissary of Ordnance at Bellary.

December 1815. Present at the reduction of Kurnool.

9. 1818. Employed at Madras on the duty of affixing Tangent Scales to all the Brass Ordnance. Commendatory Orders.

10. 1819—20—21. Went on the same duty to every station of the Madras Army, from Cape Comorin to Nagpoor, and on this journey made Barometrical Sections of the whole line of route. M. of Council, 26th March 1822. 30th April „

11. 1822. Rejoined as Commissary of Ordnance at Bellary.

12. 1824. Promoted to a Majority, and when about to join Head Quarters, found himself appointed by Sir T.

Munro, without solicitation or knowledge of the vacancy, Superintendent of the Gun Carriage Manufactory at Seringapatam.

13. While with the Gun Carriage Manufactory at Seringapatam, introduced several important reforms.

1st. Substituted the *floatage* of Timber from the Forests for 40 miles, and hire on Carts by the *weight of load* for 40 miles more, for the previous system of *Public Cattle and Carts the whole distance;* thereby in four years effecting a saving of 1½ lac of rupees.

M. of Council, 2d Nov. 1830.

2d. Introduced a new pattern Gun Carriage, and other improvements.

M. of Council, 26th Nov. 1830. From Court of Directors, 25th July 1832.

3d. Introduced important reductions and savings, by a general reform in the scale of loads of Draft Cattle, both public and hired.

Saving in the Hyderabad, Jaulnah, and Napoor Forces, of 40,000 Rs. per annum.

14. April 1830. Was removed with the G. C. Manufactory to Madras; a measure originally suggested personally to Sir T. Munro by Colonel Cullen, but left to be carried out by his successor, Mr. Lushington, who appointed Colonel Cullen, Principal Commissary of Ordnance, in addition to the Gun Carriage Manufactory, but with an Assistant in the latter Department.

Commendatory Order.

M. of Council, 28th Feb. 1832. From Court of Directors, 8th June 1836.

15. In 1832, was for a few months Officiating Military Secretary to Sir F. Adam, and for two or three months, Acting Secretary, Military Board.

16. In 1833, appointed Military Auditor General.

17. In 1834, appointed Commissary General; thereby relinquishing a salary of upwards of 3000 Rs. per month, for one of 2400.

Do. do. 21st Feb. 1838. 14th March „

18. While Commissary General, the charges of the Commissariat were reduced from ~~32 lacs in 1824, per annum, to 22 lacs in 1838~~; a very large proportion of this saving having been by reduction in the prices of supplies, and the rates of hired carriage, &c. &c.

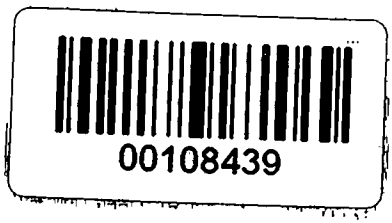
M. of Tweeddale to H. H. the Rajah of Travancore. 28th June 1847. 17th Jan. 1848.

19. In October 1840, appointed by Lord Elphinstone, Resident in Travancore and Cochin.

20. In 1844, offered by the Marquis of Tweeddale, the command of the Ceded Districts.

21. Extract from Army List:

	Total length of Service.	On leave, or on Sick Certificate.
Lieut.-General Cullen.....	55½ years.	1½ year.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